Plant Archives Vol. 22, Special Issue (VSOG), 2022 pp. 181-184 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2022.v22.splecialissue.034

IMPACT OF SOIL NUTRIENTS ON TASAR SILK WORM FECUNDITY

Chakrapani[1]*, Stuti Ananta[1], Ananta Sinha[1], Mala N.[1], Rashmi Mishra[2], K. Jena[1], I.G. Prabhu[1] and K. Sathyanarayana[1]
[1]Silkworm Rearing Management and Seed Technology,
Central Tasar Research and Training Institute, Piska Nagari, Ranchi 835303, Jharkhand, India
[2]Dr. Shyama Prasad Mukherjee University, Ranchi 834008, Jharkhand, India
***Corresponding author Email: r.chakrapani2221@gmail.com**

ABSTRACT

The nutrient composition of leaves directly affects the growth and development of tasar silkworm larvae and the economic characteristics of cocoons. In the present study, the role of nutrients such organic (Farm yard manures + green manures + biofertilizer) and inorganic(NPK) on fecundity was studied. Studies have been launched to find out the effect of soil nutrient on fecundity and retention of eggs. The results suggested that larval weight was higher (male 42.52 g and female 47.07g) inorganic treatments when compared to other treatments. However, higher shell weight (2.4gm) was detected in male cocoons of larvae feeded with host plants grown on organic supplemented soil treatments when compared with other exposure group. Organic treatments fecundity was 146, inorganic treatments 129, and control 113. The application of organic manure increases larval weight and fecundity, which may increase tasar silkworm output and productivity.

Keyword: Tasar moth, Egg laying devices

Introduction

Tasar culture is a forest-based cottage industry, which requires low investment, andhigh returns. In addition to this, it suits the tribal way of life with a positive impact on forest health and conservation of its biodiversity. Tasar silkworm is polyphagous in nature and primarily feed on most popular trees Arjun *(Terminalia arjuna),* Asan (*Terminalia tomentosa*) and Sal (*Shorea robusta)* etc. (Gupta and Sinha, 2013) . The maintenance of soil health to retain the leaf productivity and quality need alternative approach to make tropical sericulture sustainable (Reddy *et al*., 2001; Sinha *et al*., 2001; Shashidar *et al*., 2009). Inadequacy of bulk organic manure availability can be solved under low soil moisture and fertility (Leihner *et al*., 1996; Malecka and Blecharczyk, 2008) and several legume crops like sunhemp, daincha, berseem. Further, the application of green manure supplies nutrients easily to the soil and increases its moisture retention capacity compared to organic manure (Osssom and Matsenjwa, 2007; Koneetal, 2008, Pervaiz *et al*., 2009). To increase leaf yield and reduce reliance on chemical fertilizers, an experimental attempt was made to understand how different organic residues such as farm yard manures and green manures in combination with bio fertilizers influence tasar leaf yield and quality.

The leaf nutrition of tasar food plant can enhance the effective rate of rearing (ERR), health and growth of larvae and better crop yields as the feed quality has direct correlation with cocoon and shell weights, silk ratio and silk filament (Dash *et al*., 1992; Yadav *et al*., 2010). Tasar silkworm silk quality and quantity are determined by the nutritional value of their food plants (Sahay and Kapila, 1993). The nutritional content of leaves has a significant impact on the growth and development of tasar silkworm larvae as well as the economic characteristics of cocoons produced by them (Sinha *et al*., 2002). Sahay *et al*. 2001 indicated that leaf quality is one of the important factors contributing to success of tasar crops. Genital development, fecundity, and egg fertility are all influenced by larval development and feeding status (Chaudhuri, 2003; Hajarikaetal, 2003; Fischer *et al*., 2004; Saikia *et al*., 2004; Behmer 2006, Radjadi *et al*., 2009). Therefore, in the present study the impact of soil nutrition on larval character and fecundity of tasar silk worm assessed.

Material and Methods

Organic nutrients such as farmyard manures, green manures, biofertilizers, and inorganic nutrients such as NPK has been supplemented in the tasar host plant (*T. tomentosa*) at CTRTI field laboratory. The experiment was laid out in a randomized block design with three replications and three treatments like organic (farmyard manures, green manures and biofertilizers), inorganic (urea, phosphorus, potash) and control (without fertilizer). Leaf and soil samples were collected from both treated and control group.

Soil analysis

Soil pH and EC were measured through pH meter and conductivity meter, respectively. Organic carbon was determined by Walkley and Black(1934) method. Available nitrogen was determined by the alkaline permanganate method as described by John Kjeldhl (1883). Available phosphorous was determined by Bray and Kurtz (1945) method. The available potassium was measured by Hanway and Heidel (1952) method. Available sulphur was determined by the following turbidimetric Chesin and Yien (1950) method.

Leaf analysis

In three replications, leaf samples were collected from each treatment, excluding too tender and over mature leaves. On an oven dry basis, all of the biochemical constituents of leaveswere determined. Kjeldahl's method as described by Vogel (1978) was followed for the determination of total nitrogen. Crude protein was calculated by multiplying the estimated value of the nitrogen content by 6.25. Available phosphorous was analysed by method described Bray and Kurtz (1945). The method of Hanway and Heidel (1952) was used to determine the available potassium. The available sulphur was determined by the method described by Chesin and Yien (1950). Micronutrients (Ca, Cu, Fe, Mn, Zn and Mg) analysis was carried out through ICP-OES (Avion 200, Perkin Elmer, USA) at Orissa University of Agriculture and Technology, Bhubaneswar.

Rearing indices

In this experiment, silkworm larvae were reared on control and treated host plant, *Terminalia tomentosa* and allow the larva to mature and spinin natural condition.The weight of ten mature larvae selected at fifth instar from each replication was recorded and the average weight was calculated. One week after cocoon formation, ten males and ten females' cocoons were chosen at random from each replication and treatment, and weighed. Similarly, shell weight and pupal weight were also calculated bymean.

Grainage

Grainage performance of *A.mylitta D* was conducted at CTR&TI, Ranchi. From each replication 200 seed cocoons of *A. mylitta* were garlanded and kept in side wired messed cages. The nature of moth emergence and behavior of mating and fecundity were recorded during grainage operation. The moths were allowed to copulate for 8-9 hours and decoupled moths were kept individually inside sweet box for egg laying. The disease free layings (dfls) were collected and incubated at 28-30°C and R.H.70-80 %.

Table 1: Primary and secondary nutrients of *T. tomentosa* as influence by different treatments. The data are presented mean± SD of three replicates.

Parameter	Organic	Inorganic	Control
EC (dSm^{-1})	0.048±0.001	0.052±0.012	0.031±0.006
pH	6.03±0.05	6.03±0.05	5.40±0.16
Nitrogen (kg/ha)	426.49±17.73	627.21±88.59	397.22±15.64
Phosphorus (kg/ha)	248.45±10.12	268.54±6.87	195.37±18.00
Potassium (kg/ha)	355.35±60.84	407.99±108.82	256.64±29.05
Organic Carbon (%)	0.89±0.17	0.81±0.17	0.42±0.04
Sulphur (mg/kg)	67.54±9.22	55.74±8.24	44.42±2.95

Table 2: Biochemical composition of *T. tomentosa* as influenced by different treatments. The data are presented mean ±SD of three replicates.

Parameter	Organic	Inorganic	Control
Nitrogen (%)	2.19±0.05	1.79±0.24	1.78±0.11
Phosphorus (%)	1.23±0.06	1.12±0.05	0.47±0.08
Potassium (%)	1.24±0.06	1.34±0.04	0.43±0.08
Protein (%)	13.69±0.37	11.24±1.51	11.15±0.71
Calcium (mg/l)	207.71	158.29	131.29
Copper (mg/l)	0.07	0.06	0.04
Iron (mg/l)	2.77	3.15	1.88
Manganese (mg/l)	0.59	0.93	0.19
Zinc (mg/l)	0.64	1.23	0.73
Magnesium (mg/l)	8.21	7.85	6.22

Result and Discussion

The soil pH in the control plot was 5.40±0.16, but after treatment it was increased to 6.03±0.05.Organic manure containing livestock by products raises soil pH. As reported increased calcium carbonate from organic manure treatments increases buffering, thereby increasing soil pH (Eghball, 1999). Similarly, soils collected from control plot had an electrical conductivity of 0.031dSm^{-1}, inorganic soils had a conductivity- of 0.052dSm^{-1}, and organic soils had a conductivity of 0.048 dSm^{-1}. All of the samples were found to be in the normal range for electrical conductivity (EC1.0dSm^{-1}).

The availability of nitrogen in the soil and leaf increases in both inorganic and organic treatments (Table- 1&2). Nitrogen promotes root growth and phosphorus foraging capacity. Similarly, phosphorus content in soil and leaf was increased inboth organic and inorganic treatments (Table-1&2) As reported by Tisdale *et al*. (1993), approximately 50% of phosphorus is found inorganic form and organic matter decomposition produces humus, which forms complexes with Al and Fe and protects phosphorus fixation. Further, the potassium content of soil and leaf was increased in both organic and inorganic treatments when compared to the control. Organic carbon content in soil increases in both organic and inorganic treatments when compared to the control. Higher level of organic matter not only meet a portion of crop plants 'N' requirements, but also improve soil nutrient and water retention capacity and create a favorable physical, chemical, and biological environment (Kavitha *et* *al.*, 2015). The low organic matter content of the soil and the soil conditions favor nitrogen and Sulphur leaching (Ghosh and Sarkar, 1994). In the present study crude protein content was increased in the leaves of organically treated plants than in inorganic or control tasar host plants. Further, the role of secondary nutrients enhances leaf quality, moisture content, crude protein, total carbohydrate, and total minerals was reported by Sinha *et al.*, 2001.

Organic treated plants have higher levels of micronutrients such as calcium, copper, zinc, and magnesium; whereas inorganically treated plants have higher levels of manganese and iron (Table- 2). The organic carbon was evenly distributed from low to high, and the majority of soil samples' micronutrients, namely Zn, B, Fe, Mn, and Cu, were sufficient for tasar host plants. To maintain an optimum biomass yield of tasar host plant and, improved tasar silkworm cocoon quality, strategies involving the application of micronutrients via basal placement, foliar sprays, or the use of organic manures may be adopted (Pandiaraj *et al.*, 2020).

Table 3 : Effect of treatment on silkworm. The data are presented mean±SD of three replicate.

Parameter	Organic		Inorganic		Control	
	Male	Female	Male	Female	Male	Female
Larva Weight	42.53±4.12	47.07±3.30	37.36±2.57	41.70±0.32	33.52±3.51	34.23±2.15
Pupa Weight	9.27 ±0.99	13.68±0.58	10.01±1.29	13.47±1.66	10.11±1.27	13.29±1.00
Shell Weight	1.88 ±0.24	2.43 ±0.11	2.14 ±0.07	2.50 ±0.32	2.40 ±6.31	2.43 ±0.21
Cocoon Weight	11.27±1.12	16.27±0.64	12.26±1.36	15.42±1.36	12.72±1.41	15.74±1.40

Larvae feed on food plants, which grow on soil treated with organic nutrients, increases larva weight. However, enhanced pupa weight, shell weight, and cocoon weight was observed in inorganic nutrient treatment plots. The larval nutrition have a significant impact on the reproductive efficiency of female insects (Pattanayak *et al.*, 2000; Reddy *et al.*, 2009), which may explain male cocoons have better silk while female cocoons have better pupae due to their prioritized budgeting of food reserves. The rate of larval growth and development is determined by its feeding status, which has been linked to adult fertility and fecundity (Hajarika *et al.*, 2003; Radjabi *et al.*, 2009). Further, fecundity of silk moth was higher in organic treated groups (146 ± 38.01) when compared to inorganic treated groups (129 ± 36.43), and control group (113 ± 34.25). The quantity and number of required amino acids in the food plant leaf play a larger role in vitellogenesis, influencing the number, size and fertility of eggs in insects (Chapman2009; Saikia, 2014).

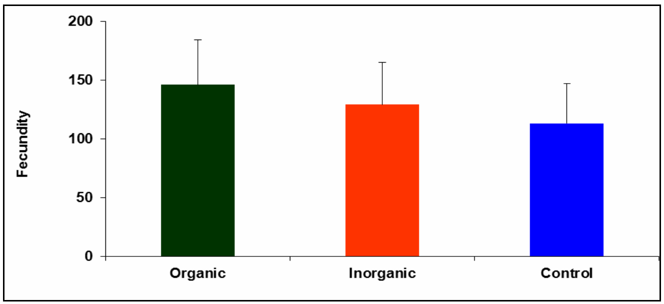

Fig. 1 : Fecundity of tasar silkworm as influence by different treatments

The silkworm rearing and fecundity performance of cocoons harvested from foodplants are influenced by different treatments such as organic and inorganic nutrients. Traits like cocoon weight, shell weight show positive response in organic as well as inorganic treatment. But fecundity increase in organic treatment as compare to inorganic and control that show demonstrating the advantage of tasar silkworm silk productivity.

Acknowledgements

The authors acknowledge the grant provided by the Central Silk Board (CSB), Ministry of Textiles, Government of India (Project Code: APS04003SI). The authors also thank to Central Instrumentation Facilities Centre, Odisha University of Agriculture and Technology (OUAT) Bhubaneswar for providing instrumental analysis facilities.

References

Behmer, S.T. (2006). Insect dietary needs: plants as food for insects. Encyclopedia of Plant and Crop Science, 1-4.

Bray, R.H. and Kurtz, L.T. (1945). Determination of total organic, and available forms of phosphorus in soils. *Soil science*, 59(1): 39-46.

Chapman, R.F. and Chapman, R.F. (1998). The insects: structure and function. Cambridge university press.

Chaudhari, M. (2003). Studies on relationship between silk yield components and rearing environment of muga silkworm *Antheraea assama*, *Sericologia,* 43: 349-354.

Chesnin, L. and Yien, C.H. (1951). Turbidimetric determination of available sulfates. *Soil Science Society of America Journal*, 15(C): 149-151.

Dash, A.K.; Nayak, B.K. and Dash, M.C. (1992). The effect of different food plants on cocoon crop performance in the Indian tasar silkworm *Antheraea mylitta* Drury (Lepidoptera: Saturniidae). *J. Res. Lepid*, *31*(1-2): 127-131pp.

Eghball, B. (1999). Liming effects of beef cattle feed lot manure or compost. Communications in Soil. *Science and Plant Analysis*, 30(19-20), 2563-2570.

Ghosh, G.K. and Sarkar, A.K. (1994). Availability of sulphur and some micronutrients in acid sedentary soils of Chotanagpur region. *Journal of the Indian Society of Soil Science,* 42(3): 464-466.

Gupta, V.P. and Sinha, M.K. (2013). Food plant maintenance, silkworm rearing and seed production. Illustrated Manual of Tropical Tasar Culture Technology.

Hajarika, U.; Barah, A.; Phukan, J.C.D. and Benshamin, K.V. (2003). Study on the effect of different food plants and seasons on the larval development and cocoon characters of silkworm, *Samia Cynthiaricini* Boisduval. *Bulletin of the Indian Academy of Sericulture,* 7: 77-85.

Hanway, J.J. and Heidel, H. (1952). Soil analysis methods as used in Lowa State College, Soil Testing Laboratory, *Lowa State Collage Bull.*, 57: 1-131.

Kavitha, C. and Sujatha, M.P. (2015). Evaluation of soil fertility status in various agro ecosystems of Thrissur District, Kerala, India. *International Journal of Agriculture and Crop Sciences (IJACS)*, 8(3): 328-338.

Kjeldahl, J.Z. (1883). A new method for the determination of nitrogen in organic bodies. *Analytical Chemistry,* 22: 366.

Koné, A.W.; Tondoh, J.E.; Bernhard-Reversat, F.; Loranger-Merciris, G.; Brunet, D. and Tano,

Y. (2008). Changes in soil biological quality under legume- and maize-based farming systems in a humid savanna zone of Côte d' Ivoire. *BASE.*

Leihner, D.E.; Ruppenthal, M. and Hilger, T.H. (1996). Soil conservation effective ness and crop productivity of foragel egume inter cropping, contour g rass barriers and contour ridging in cassava on Andean hill sides. *Experimental Agriculture*, 32(3): 327-338.

Małecka, I. and Blecharczyk, A. (2008). Effect of tillage systems, mulches and nitrogen fertilization on spring barley (*Hordeum vulgare*).*Agron. Res*, 6(2): 517-529.

Ossom, E.M. and Matsenjwa, V.N. (2007). Influence of mulch on agronomic characteristics, soil properties, disease and insect pest infestation of dry bean (*Phaseolus vulgaris* L.) in Swaziland. *World Journal of Agricultural Sciences*, 3(6): 696-703.

Pandiaraj, T.; Srivastava, P.P. and Susmita Das, S.A. (2017). Evaluation of soil fertility status for soil health card in various tasar growing fields of Bihar and Jharkhand States, India. *Int. J Curr. Microbiol. App. Sci,* 6(4): 1685-1693.

Pattanayak, J. and Dash, A.K. (2000). Allocation of energy for cocoon and pupal life of matured larva of *Antheraea mylitta* (Drury) (Saturniidae), the Indian tasar silk insect. *Sericologia*, 40(4): 657-663.

Pervaiz, M.A.; Iqbal, M.; Shahzad, K. and Hassan, A.U. (2009). Effect of mulch on soilphysical properties and N, P, K concentration in maize (*Zea mays* L.) shoots under two tillage systems. *Int.J. Agric.Biol*, 11(2): 119-124.

Radjabi, R.; Ebadi, R.; Mirhoseini, S.Z. and Nair, S. (2009). Effects of feeding alanine-enriched mulberry leaves on the economic characters of the silkworm *Bombyx mori* (Lepidoptera: Bombycidae). *Formosan Entomologist*, 29: 73.

Reddy, P.S.; Rao, T.V.S.S. and Venkataramana, P. (2001). Vermicompost in management of nutrients and leaf yield inV-1 mulberry variety. *J. Environ. Res*, 11: 137-140.

Reddy, R.M.; Hansda, G.; Ojha, N.G. and Suryanarayana, N. (2009). Utility scope of hybridization in seed production of tropical tasar silkworm *Antheraea mylitta* Drury.*Sericologia*, 49(4): 547-551.

Sahay, A.; Sahay, D.N. and Thangavelu, K. (2001). Disease management during tasar seed production. In Workshop on Tasar seed production, planning and grainage. *Central Tasar Research and Training Institute, Ranchi* (pp.32-45).

Sahay, A. and Kapila, M.L. (1993). Role of nutrition in synthesis of tasar silk. *Indian Silk*, 30(2):8.

Saikia, S.; Handique, R.; Pathak, A. and Das, K. (2004). Rearing performance of muga on the primary and secondary food plants with an attempt for the revival of now extinct mejankari silk heritage of Assam. *Sericologia*, 44(3): 373-376.

Shashidhar, K.R.; Bhaskar, R.N.; Priyadharshini, P. and Chandrakumar, H.L. (2009). Effect of different organic mulches on pH, organic carbon content and microbial status of soil and its influences on leaf yield of M.mulberry (*Morus indica* L.) under rainfed condition. *Curr.Biotica*, 2: 405-413.

Sinha, A.K.; Sinha, U.S.P.; Banerjee, N.D.; Prasad, J. and Brahamchari, B.N. (2002). Effect of foliar spray of micronutrients on leaf yield of *Terminalia arjuna* and quality of cocoons produced on them. *Plant Archives*, 2(2): 151– 155.

Sinha, A.K.; Srivastava, B.R.P.D. Sinha and Thangavelu, K. (2001). Direct and indirect effects of quantitative characters on silk yield in eight inbred lines of *Anteraea mylitta* Drury; Persoect.*Genet.,* 10: 849-852.

Tisdale, S.L.; Nelson, W.L.; Beaton, J.D. and Havlin, J.L. (1993). Soil Fertility and Fertilizers, 5th Edition, Macmillan Publishing Co.; New Delhi. pp:144, 180, 198, 201.

Walkley, A.J. and Black, I.A. (1934). Estimation of soil organic carbon by chromic acid titration method, *Soil Sci*., 37: 29-38.

Vogel, A.I. (1978). A text book of quantitative inorganic analysis including elementary instrument alanalysis, 4 th edition, Longman Group Ltd.; London.

Yadav, G.S. and Mahobiam, G.P. (2010). Effect of different food leaves on rearing performance in Indian tropical tasar silkworm *Antheraea mylitta* Drury (Lepidoptera: Saturniidae). *Uttar Pradesh J Zool.,* 30(2): 145-152.